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CENTRAL INTELLIGENCE AGENCY
WASHINGTON 25. D. C

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MEMORANDUM FOR: The Director of Central Intelligence

SUBJECT : "Combat Against Enemy Nuclear Artillery, Free Rockets, and Guided Missiles in Offensive and Defensive Operations of an Army" (Chapter V)

1. Enclosed is a verbatim translation of Chapter V of a seven-chapter TOP SECRET Soviet publication entitled "Combat Against Enemy Nuclear Artillery, Free Rockets, and Guided Missiles in Offensive and Defensive Operations of an Army". It was issued by Scientific-Research Artillery Institute No. 1 in Leningrad in October 1960.

2. For convenience of reference by USIB agencies, the codeword IRONBARK has been assigned to this series of TOP SECRET CSDB reports containing documentary Soviet material. The word IRONBARK is classified CONFIDENTIAL and is to be used only among persons authorized to read and handle this material.

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Richard Helms

Richard Helms
Deputy Director (Plans)

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cc: The Director of Intelligence and Research, Department of State

The Director, Defense Intelligence Agency

The Director for Intelligence, The Joint Staff

The Assistant Chief of Staff for Intelligence, Department of the Army

The Director of Naval Intelligence Department of the Navy

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COUNTRY : USSR

SUBJECT : "Combat Against Enemy Nuclear Artillery, Free Rockets, and Guided Missiles in Offensive and Defensive Operations of an Army" (Chapter V)

DATE OF INFO : October 1960

APPRAISAL OF CONTENT : Documentary

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Following is a verbatim translation of Chapter V of a TOP SECRET Soviet publication titled "Combat Against Enemy Nuclear Artillery, Free Rockets, and Guided Missiles in Offensive and Defensive Operations of an Army". This document contains seven chapters and was published on 15 October 1960 by Scientific-Research Artillery Institute No. 1 in Leningrad. Each chapter will be disseminated as it becomes available and is translated.

In some cases, there are imperfections in the original text which leave doubt as to the accuracy of translation. Question marks are inserted in brackets following uncertain words or phrases. As in other IRONBARK reports, transliterated Cyrillic letters are underlined in translation, while Greek and Roman letters are given as in the original.

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Chapter V

"Destruction of Enemy Offensive Nuclear Weapons by Artillery"

Depending on its capabilities, artillery may be employed to destroy "Lacrosse" guided missiles, "Honest John" and "Little John" free rockets, and 280mm and 203.2mm guns while these are located at firing or waiting positions (vyzhidatelnaya pozitsiya), or else during the time of moving them from one position to another. Also, artillery may be employed for firing at technical positions and transport with nuclear warheads.

Each one of the above targets has its own features and calls for an individual approach when working out recommendations for its destruction. Let us evaluate these targets from the viewpoint of their vulnerability to artillery fire.

I Stipulated Target Zone (Dimensions)

The full characteristics of the destructive action of shells on any target are based on the law of destruction (zakon porazheniya), which establishes the interrelation between the probability of target destruction and the distance of the burst from the target. Nevertheless, calculations based solely on the law of destruction are linked with certain difficulties. Therefore, as a rule, one of its characteristics is used in practice - the projectile moment of distribution (pulevoy moment raspredeleniya) - which is known as the "stipulated target zone" (privedennaya zona tseli). The stipulated target zone is a convenient and objective characteristic of the action of shells on targets. Physically, this is a conventional (uslovnyy) area of definite size, the probability of even one hit on which is numerically equal to the probability of destruction of the target.

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Each target has its own stipulated zone.

The targets under review are by nature individual combined targets composed of elements of different vulnerability (equipment, projectile, personnel). This circumstance creates a certain amount of difficulty in finding a law of destruction for them. Moreover, finding a law of destruction, and therefore the exact size of the stipulated target zone for such targets as enemy offensive nuclear weapons, is practically impossible for the time being, in view of the absence of data of any kind on their vulnerability to artillery shells. Therefore, one is obliged to use approximate characteristics obtained by indirect means.

In such cases, the stipulated zone is also often calculated on the basis of logical considerations, without any knowledge of the law of destruction. We shall be using this method for certain targets in this work.

1. Stipulated Zone of a Launching Mount (280mm Gun) Located at a Firing Position (S_{op})

Launching mounts for "Lacrosse" missiles and "Honest John" and "Little John" rockets as well as 280mm guns occupy a firing position as a rule for one round, after which they move to a waiting position (cover). For this reason, as a rule firing positions are not equipped from the engineer viewpoint.

As a target, a launching mount (gun) at a firing position is a mount (combat vehicle or gun) in a loaded

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state * located on an open site manned by a crew engaged in preparations to fire the round.

The vulnerable elements of such a target are considered to be: the projectile, the equipment of the mount (gun), and the crew located in the open (it is assumed that after the first bursts of shells in the vicinity, the crew will lie flat).

The sizes of the launching mounts (280mm guns) taken from /19/ are given in Table 29.

Table 29

Sizes of Launching Mounts (280mm Guns)

Systems	Length l (m)	Width m (m)	Height h (m) with the least φ
1	2	3	4
"Lacrosse" guided missiles	7.7	3	4.2
"Honest John" free rocket	10	3	3
"Little John" free rocket	5	2.3	1.8
280mm gun T-131	12	3.1	2.8

---

* The loading of launching mounts is carried out, as a rule, at the waiting position (in the assembly ((sbor)) and shelter area) or at the technical position. The loading of 280mm guns is done directly at the firing position, and for this reason, at the time of loading, beside the gun itself at the firing position there will be the vehicle with the shell.

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Up to now, the stipulated target zone of such a target as an enemy launching mount (280mm gun) at a firing position was taken to be the geometric dimensions of the mount (gun), taking into account the shadow projection, increased by a certain arbitrarily chosen radius of fragmentation (blast) effect of the shell on equipment. In our view, the stipulated target zones obtained by such methods do not wholly reflect the capabilities of artillery shells in destroying enemy launching mounts (guns). Study of information available on launching mounts, as well as their ammunition, gives us ground to estimate their present vulnerability to shell splinters. It would also be advisable to take into account the fragmentation action of shells on the crew (personnel) working near the launching mount (gun).

Governed by the desire to make a fuller consideration of the destructive capabilities of artillery firing at enemy launching mounts (280mm guns) located at firing positions and lacking definite data on their vulnerability, the writers of this study decided to follow the course of using available data on the action of shells on targets bearing most resemblance to the ones under review.

In particular, to determine stipulated target zones for "Lacrosse" guided missiles and "Honest John" and "Little John" free rockets, we used results of experimental firing being carried out by the writers of study /20/, with the aim of determining the stipulated zone for a SON-4 radar set by experimental means. The stipulated zone for a 280mm gun was determined by using the coordinate area of destruction of a 152mm M-47 gun, obtained in study /21/.

The reason for using the experimental data in study /20/ to determine the stipulated zone for "Lacrosse" guided missiles and "Honest John" and "Little John" free rockets is the fact that missiles and launching mounts can withstand roughly the same amount of fragmentation and blast effect from a shell as the SON-4. This is shown in the following data.

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It has been shown in study [20] that in order to put a SON-4 radar set out of action, it is essential for a splinter to penetrate the wall of the set and the wall of the cabinet (unit) containing the radio technical equipment. At the same time the splinter should have a specific energy in the region of 700 kgm/cm^2.

There is every reason to believe that in order to put a missile or a launching mount out of action it is necessary for a splinter to penetrate either the casing of the missile or the balancing column (uravnoveshivayushchaya kolonka), and in the case of the "Lacrosse" the wall of the automatic checkout apparatus (electric power unit). Note that the main part of the vulnerable surface is the surface of the missile. There is no information on the casing thickness of "Lacrosse," "Honest John," and "Little John" missiles. Comparing them to similar missiles produced here at home, it may be assumed that the thickness of the casing of an "Honest John" should be in the region of 8mm and that of the "Lacrosse" and "Little John" should be in the region of from 4 to 6mm, provided the missile is made of steel of medium hardness. Naturally, if they are made of harder steel, the thickness of the casing may be reduced.

Rockets (missiles) are of cylindrical shape. The amount of energy of the splinter required to penetrate a cylindrical surface will be greatly influenced by the angle of impact (vstrecha) of the splinter with the obstacle. We shall consider the angle of impact to be the angle ψ between the tangent at the point of impact of the splinter with the obstacle and the direction of flight of the splinter. The maximum angle of impact ψ may be taken as 40^o.

According to experimental data of GNIAP GAU [22] (Glavnyy Nauchno-Issledovatelskiy Artilleriyskiy Poligon Glavnogo Artilleriyskogo Upravleniya - Main

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Scientific Research Artillery Range of the Chief Artillery Directorate), a splinter should have the specific energy shown in Table 30 in order to penetrate a steel sheet of medium hardness.

Table 30

Specific Energy of Splinter (in kgm/cm^2)

Required to Penetrate a Steel Sheet

Weight of splinter (kg)	Angle of impact ψ (degrees)	Thickness of steel sheet		Remarks
		6mm	8mm	
3	90	112		The average is arrived at as a result of dividing by five the specific energy at ψ - 90°, the doubled specific energy at ψ -60°, and the doubled specific energy at ψ -40°.
	60	224	-	
	40	274		
		Average 222		

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Weight of splinter (kg)	Angle of impact ψ (degrees)	Thickness of steel sheet 6mm	8mm	Remarks
5	90	135	200	As above
	60	188 [?]	2?4 [?]	
	40	250 [?]	297 [?]	
		Average 202 [?]	Average 282 [?]	
10	90	104	197	
	60	195	230	
	40	272	3?0	
		Average 208	Average 283 [?]	

It will be seen from Table 30 that the required specific energy of a splinter practically does not change with the change of weight of the splinter but depends in the main on the angle of impact*; for a steel sheet of medium hardness 6 to 8mm thick, the required specific energy of the splinter may be taken on the average as being equal to 240 kgm/cm^2. If one takes into consideration the possible change in the elevation angle of a missile, which may lead to a reduction in the angle of impact, which in turn will require an increased specific energy of the splinter,

* With ψ less than [?] 40°, the necessary specific energy is [one word missing].

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then it may be assumed that, in order to penetrate the casing of a missile, the splinter should have a specific energy of roughly ?00 kgm/cm^2.

On the basis of the above assumption, the stipulated zone for "Lacrosse" guided missiles and "Honest John" and "Little John" free rockets may be calculated as follows:

We know the stipulated zone S'_c for SON-4 obtained from [20] for average conditions (θ_c- 40°), which can be formulated thus:

$$S'_c = S'_{??'} + S'_? + S'_{???} \qquad (17)$$

where S'_c is the stipulated zone for SON-4 equal to 495 [?] m^2 for a 122-mm howitzer, 480 [?] m^2 for a 130-mm gun, and 585 [?] m^2 for a 152-mm howitzer and gun;

- $S'_{??}$ is the part of S'_c equal to the area occupied by [?] the radar ($S'_{??}$-16.? m^2);
- $S'_?$ is the part of S'_c equal to the shadow projection of the radar (where θ_c - 40°, $S'_?$ - 38.5 [?] m^2;
- $S'_{???}$ is the part of S'_c that coincides with the area [?] of fragmentation and blast effect of the shell on the equipment which is equal to 440 m^2 for a 122mm howitzer, 425 m^2 for 130mm gun, and 530 m^2 for a 152mm howitzer and gun.

Having got this data, and using the corresponding coefficients which allow one to convert from the conditions under which S'_c was obtained to conditions of firing at launching mounts, it is possible to calculate the respective stipulated zones. The formula for the approximate calculations of the stipulated zone S_{op} of a launching mount located at a firing position will look as follows:

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$$S_{op} = S_{mch} + S_{r} + \chi \times \nu \times S'_{o/mch} \qquad (18)$$

where S_{mch} is the area taken up by the launching mount

$$S_{mch} = \ell \times m; \qquad (19)$$

S_t is the stipulated dimensions of shadow projection of the launching mount;

$$S_t = \frac{h}{\ell ? \theta_c} (\ell \sin\alpha + m \cos\alpha)$$

where h is the stipulated height of launching mount;

α is the angle between plane of fire of our battery and the longitudinal axis of the enemy launching mount (for calculations α is equal to zero);

χ is the coefficient which takes into account change in effective fragmentation action of a shell on equipment when moving from conditions of fire at θ_c - 40° [?] to the effective conditions; the coefficient values of χ are given in Table 31.

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Table 31

Values of χ Coefficient

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[Range?] (km) [?]	Values of coefficient χ for change-over from θ_c -40° [60°?] to effective							
	θ_c	122mm How	θ_c	152 mm How	θ_c	130mm Gun	θ_c	152mm Gun
?	?	0.98	37[?]	0.?4	?1	0.??	22[?]	0.9
?	43[?]	1.00	??	0.?5	-	-	-	-
?	56[?]	1.2?	61[?]	1.??	?1	0.91[?]	32[?]	0.9[?]
?					41[?]	1.01[?]	?7	0.99[?]
?					43[?]	1.11	55[?]	1.27
?					55[?]	1.3[?]	-	-
?					60[?]	1.54[?]	-	-

ν is a coefficient which takes into account the change in effectiveness of the fragmentation effect of a shell on equipment with changes in the area of the vulnerable surface*.

$$\nu = \left(\frac{P_i}{P_c}\right)$$

* [Two words illegible] given in study [20]

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where $\underline{P}_c$ and $\underline{P}_i$ is the total vulnerable surface respectively of a SON-4 radar set and a launching mount with a missile.

The total vulnerable surface area of a SON-4 radar set (P_c) is understood to be the area situated in the best zone of splinter flight (when the burst of the missile is on the right, left, and in front of the radar set. The total vulnerable surface area of the radar set is: $P_c = 8{\cdot}12\ m^2$, taking into account the coefficient of filling the assembly with radio-technical equipment as equal to 0.7 according to study [20].

The total vulnerable surface area of a launching mount with a missile was determined on the same basis as in the case of SON-4. The following were considered to be vulnerable: the surfaces made up by the missile, the balancing column, and in addition, in the case of "Lacrosse", by the automatic checkout device of the missile (electric power supply unit), with the shell burst to the right, left, and in front of the launching mount. The width of the vulnerable part of the cylindrical surface was taken to be equal to

$$D_{\underline{u}} = [?]\, D_{\underline{ts}} \cos \psi \qquad (21)$$

where $D_{\underline{ts}}$ is the diameter of cylindrical surface of the missile (balancing column);

ψ is the angle of impact (in calculation value is taken as $\psi = 40^{\circ}$).

Data on the vulnerable surfaces of the "Lacrosse," "Honest John," and "Little John" when located at firing positions, as well as the values of coefficient ν are given in Table 32.

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Table 32

Area of Vulnerable Surface and Values of Coefficient

?	Description	"Lacrosse"	"Honest John"	"Little John"
1	2	3	4	5
1	Stipulated length of vulnerable part of missile (raketa) (m)	5.2	8.34	3.2
2	Stipulated width of vulnerable part of missile (m)	0.4	0.48	0.25
3	Vulnerable area of missile (m^2) when the shell burst is on right (left)	2.08	4.	0.8
4	Vulnerable area of balancing column (m^2) when the shell burst is on right (left)	0.1	0.25	0.17
5	Vulnerable area of the automatic checkout device of the missile (snaryad) (electric power unit), taking into account the filling coefficient (0.7) when the burst is on right (left).	1.12	-	-
6	Total vulnerable area when shell burst is on right (left)	3.3	4.25	0.97

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?	Description	"Lacrosse"	"Honest John"	"Little John"
1	2	3	4	5
7	Total vulnerable area when the shell burst is in front *	1.27	0.?	0.27
8	[Word illegible] vulnerable area	?.?	?.0	2.21
9	[?]	0.??	1.11[?]	0.27
10	[?]	0.??	1.05[?]	0.48

* For the "Honest John" and "Little John" the vulnerable area of the balancing device has been obtained [?] only for the mean angle of elevation [?] for "Lacrosse", for that open [?][work missing] part of the missile [word missing] at an angle of elevation [?] of 70° [?].

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The sizes of stipulated zones for "Lacrosse" guided missiles and "Honest John" and "Little John" free rockets when located at firing positions are shown in Table 34. It should be noted that the stipulated zones which were obtained did not take into consideration the effect of fragmentation on the crew. Moreover, the effect of ricochet splinters capable of leaving scratches and dents on the surface of the missile were ignored, as were their effect on the tail assembly, stabilizing fins, and the launching mount. For this reason the stipulated zones obtained can be only underestimated. At the same time, the calculation of the change of width of the vulnerable part of the cylindrical surface, depending on the distance of the burst from the launching mount, was carried out roughly, and this could have led to a certain overestimate of the results obtained. On the whole, though, the stipulated zones shown in Table 34 indicate approximately the true nature of the destructive effect of shells on enemy mounts located at firing positions.

In determining the stipulated zone for a 280mm gun located at a firing position, use was made of the coordinate (koordinatnyy) law of destruction of a 152mm M-47 gun located on an open site and which was obtained from [21] for conditions when firing at the gun and at the gun crew, located near the gun in kneeling position (the stipulated zone of a rifleman in kneeling position) is carried out by a 122mm shell by direct laying (the angle of descent φ-3°).

The analysis of the nature of this law made it possible to determine the part played by the destructive effect of a 122mm shell on certain vulnerable elements of the target when the shell hit the stipulated target zone, and in particular the part played by the fragmentation effect of the shell on the equipment and the crew. In other words, if S'_{op} is the stipulated zone for a 152mm gun located at an open firing position, it has been possible to determine its components:

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$$S'_{\underline{op}} = S'_{\underline{mch}} + S'_{\underline{t}} + S'_{\underline{o/mch}} + S_{\underline{o/r}}$$

where S'_{mch} is the part of S'_{op} equal to the area occupied by the gun;

S'_t is the part of S'_{op} equal to the shadow projection of the gun;

$S'_{o/mch} = 65\ m^2$ is the part of S'_{op} that coincides with the fragmentation action of the shell on the gun equipment, and

$S'_{o/r} = 55\ m^2$ is the part of S'_{op} that coincides with the fragmentation action of the shell on the crew.

Having this data and using the appropriate coefficients which make it possible to change over from conditions in which the S'_{op} was obtained to conditions of firing at an enemy 280mm gun, it is possible to calculate the corresponding stipulated zones. The formula for the approximate calculation of the stipulated zone (S_{op}) for a 280mm gun located at a firing position looks as follows:

$$S_{\underline{op}} = S_{\underline{mch}} + S_{\underline{t}} + \chi \nu S'_{\underline{o/mch}} + \chi f S'_{\underline{o/r}} \qquad (22)$$

where, by analogy with formula (19) S_{mch} is the area occupied by the 280mm gun while S_t is ~~the~~ stipulated dimensions of the shadow projection of the gun:

χ is the coefficient which takes into account the change in the effective fragmentation action of the shell on the crew and equipment when converting from conditions at which the law was obtained (122mm shell $\theta_c = 3^\circ$) to the effective conditions (caliber of shell different from 122mm, $\theta_c \neq 3^\circ$).

The values of coefficient χ calculated on the basis of [23] are given in Table 33.

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Table 33

D [Range] (km)	Values of coefficient χ when firing from:			
	122mm How	152mm How	130mm Gun	152mm Gun
8	1.2	1.75	1.1	1.63
10	1.27	1.72	-	-
12	1.58	2.28	1.17	1.63
16	-	-	1.29	1.72
20	-	-	1.41	2.3
24	-	-	1.5	-
26	-	-	1.7	-

ν is the coefficient which takes into account the change in the effective fragmentation action of a shell on equipment with the change in size of the surface vulnerable to splinters, when converting from conditions for which the law was obtained (from P_{or}) to the actual conditions. A comparison between the 280mm and 152mm guns shows that the 280mm gun has more elements vulnerable to splinters and therefore has a larger vulnerable area as compared with the 152mm gun. Nonetheless, it is difficult to express in figures the ratio between the vulnerable surfaces of a 280mm gun and that of a 152mm gun. For this reason, we will take this ratio and therefore also the value of coefficient ν to be equal to one.

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f is the coefficient which takes into account the change of effective fragmentation action of a shell on the crew depending on changes in the vulnerable surface of an individual rifleman when converting from conditions for which the law was obtained ("riflemen in kneeling position" - $\delta_{?} = 0.55\ m^2$) to the actual conditions ("riflemen in a prone position" - $\delta_{?} = 0.25\ m^2$).

According to the studies [24] and [25] for angles θ_c = 30 to 60°, the doubling of the size of the rifleman will lead to an increase in size of the stipulated zone of the rifleman (δ) on average by 1.6 times. Hence $f = \frac{\delta_1}{\delta_?} \approx 0.8$.

Values of the stipulated zone for a 280mm gun located at a firing position, calculated according to formula (22), are given in Table 34.

Table 34

Stipulated Zones of Launching Mounts (280mm guns) Located at Firing Positions (S_{op})

Arty. Systems	D [Range] (km)	S_{op} for:			
		"Lacrosse"	"Honest John"	"Little John"	T-131 280mm Gun
122mm How	8	470	495	225	180
	10	485	520	230	185
	12	580	625	280	200

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Arty. Systems	D [Range] (km)	S_{op} for: "Lacrosse"	"Honest John"	"Little John"	T-131 280mm Gun
152mm How	8	550	580	260	245
	10	545	580	260	245
	12	700	740	335[?]	290
130mm Gun	8	430	455	200	1?0
	12	435	4?5	210	180
	16	460	490	220	190
	20	500	5?0	240	200
	24	540	575	260	210
	28[?]	600	640	280[?]	220
152mm Gun	8	520	560	250[?]	230[?]
	12	520	5?0	250[?]	280[?]
	16	645[?]	675	260[?]	?40
	20	700	745	???	??5

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2. Stipulated Zone of a Battery of 203.2mm Guns Located at a Firing Position

As a rule 203.2mm guns occupy firing positions by battery. The firing position of a 203.2mm howitzer battery is equipped in the same way as the firing position of an ordinary battery. As a target, a battery of 203.2mm guns located at a firing position represents 4 guns located in full-section pits (okop polnogo profilya) with personnel (crews) either in shelters or inside the pits. The frontage of the battery is taken to be 150m and its depth 40m. Vulnerable elements of such a target are the gun equipment and ammunition, as well as crews located in the gun pits.

We shall take the reduced zone of a 203.2mm gun located at a firing position to be that of the stipulated dimensions of the gun pit (S_{op}), calculated according to the formula:

$$S_{op} = P\ (R_{??} + r_f\ )^2/?/ \qquad (23)$$

where $R_{??}$ is the stipulated radius of a 203.2mm howitzer pit at ground level;
r_f is the radius of the shell hole, taken to equal 1.5m for 122mm and 130mm shells and 2m for 152mm shells.

The stipulated zone for a 203.2mm gun located at a firing position calculated according to the formula (23) is $145m^2$ when firing guns of 122mm and 130mm caliber, and 160 /?/m^2 for guns of 152mm caliber.

It may be assumed that to fire nuclear ammunition an individual gun from the battery could be moved to a temporary firing position. In that case we shall take the stipulated zone of the 203.2mm gun to be that of a 280mm gun at the firing position.

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3. Stipulated Zone of a Launching Mount (280mm gun) Located at a Waiting Position

Launching mounts and 280mm guns at waiting positions, as a rule, are located in an open pit of limited size, ensuring protection for the vulnerable parts of the mount (gun) and projectile (if the mount has the projectile at the waiting position from the fragmentation effects of a close shell burst. Because 280mm guns and "Little John" launching mounts are located in pits together with their prime movers, the pits are naturally meant to shelter the prime movers as well.

This requirement is met by a pit whose depth is approximately equal to one half to two thirds of the height of the launching mount (gun). The part of the launching mount (gun) which is above ground level, will be sheltered by the parapet. The personnel at waiting position as a rule are located in shelters.

Therefore the vulnerable elements of such a target as a launching mount (gun) at a waiting position are the mount (gun) equipment and prime movers located in pits, as well as personnel who for some reason are not using shelters.

We shall reckon that a launching mount (gun) will be put out of action if a shell bursts inside the pit, which would be equivalent to a direct hit on the mount (gun), or at a distance from the edge [?] of the pit not greater than the radius of the shell crater - r_f.

We shall take the stipulated zone of a launching mount (280mm gun) at a waiting position to be the stipulated size of the pit (S_{vp})

$$S_{vp} = (\ell' + 0.44h + r_f)(m + 0.44h + r_f) \qquad (24)$$

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where ℓ' is the length of the mount together with prime mover;
m is the width of the mount;
h is the height of the mount.

The value 0.44h, numerically equal to the slope, is derived from the following considerations.

The ratio of the slope (Z) to the depth of the gun pit (G) for medium soils is taken to equal $\frac{2}{3}$. In turn, the depth of the gun pit is taken to equal (G) = $\frac{2}{3}$h. Hence $Z = \frac{2}{3} G = \frac{4}{9}h = 0.44h$.

The values of ℓ', m, and h correspond to the ones shown in Table 27, except for the 280mm gun, in whose case ℓ' is taken to equal 25.6m and h - 3.7m, and the "Little John" launching mount, in whose case ℓ' is taken to equal 12.6m (length of launcher - 5m, and length of prime mover - 7.6m).

The values of S_{vp} calculated according to formula (24) are given in Table 35.

Table 35

Systems	Values of S_{vp} (m^2) when firing:	
	122mm How 130mm Gun	152mm How and Gun
"Lacrosse" guided missile	70	?0
"Honest John" free rocket	74	?4
"Little John" free rocket	7?	??
T-131 280mm gun	178 [?]	1??

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4. Stipulated Zone of a Launching Mount (280mm Gun) on the March

The launching mount for "Lacrosse" missiles or "Honest John" rockets are individual combat vehicles which can move independently, whether with or without the missile or rocket.

The launching mount for the "Little John" rocket is towed by a prime mover when changing position. It may also be armed with a rocket. A 280mm gun on the march is a train made up of two prime movers with the gun between them. The dimensions of the mounts (trains) were given previously.

As a rule, the mount or gun crews make the move on a separate vehicle (vehicles) following at a considerable distance from the mounts (guns).

Vulnerable elements of a target such as a launching mount (gun) on the march are the mount (gun) equipment and traction equipment located on the open road, as well as those personnel who accompany the mount (gun) and are in the cab.

Launching mounts with "Lacrosse" missiles or "Honest John" rockets on the march, by their nature, differ little as targets from when they are located at a firing position and, for this reason, allowing for a certain amount of error, the stipulated zones of these mounts on the march are taken as the same as in the case of their being located at a firing position [?].

The stipulated zones that represent [?] them located at a firing position, increased by the area and shadow projection of the prime movers, are also taken to serve as stipulated zones for a mount with a "Little John" rocket or a 280mm gun on the march [?].

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The values of the stipulated zones obtained in this way of a mount and 280mm gun on the march (S_M) are given in Table 36.

Table 36

D /Range7 (km)	S_M "Little John" when firing from:				S_M 280mm gun when firing from:			
	122mm How	152mm How	130mm Gun	152mm Gun	122mm How	152mm How	130mm Gun	152mm Gun
8	250	340	270	340	370	440	440	440
10	270	340	-	-	340	440	-	-
12	300	410	270	340	340	480	380/?7	440
16	-	-	270	350	-	-	550	430
20	-	-	280	420	-	-	340	440
24	-	-	290	-	-	-	340	-
26 /?7	-	-	320	-	-	-	360	-

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5. Stipulated Zone of Transport Equipment with Nuclear Ammunition

Missiles ready for firing (mated) (stykovannyy) are carried to the firing or waiting position either directly on the launching mounts or by special transport equipment.* Allowing for a certain amount of error, it can be reckoned that such transport carrying nuclear ammunition will in practice not differ in vulnerability from the corresponding launching mounts when located at the firing position. Therefore, the stipulated zone for transport carrying nuclear ammunition (S_{tr}) can be taken as that of the corresponding mount with missile, when located at a firing position.

6. Stipulated Zone of a Technical Position

A technical position as a target is a camouflaged site of limited area at which are located in pits vehicles with special equipment for checking out the body and nose cone of the missile (rocket), assembly, and transfer to the launching mount or transport (carrier). To carry out some of these operations, at least two special vehicles must leave the shelter and park near the launching mount (transport). At that moment the technical position becomes most vulnerable to artillery fire. The vulnerable elements of such a target are: the missile, the equipment part of the special vehicles, and the launching mount (transport), as well as the personnel working near the vehicle.

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* Nuclear ammunition for 280mm and 203.2mm guns is carried in a vehicle which it is practically impossible [?] to distinguish from conventional ones.

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In general (at the moment of detection) the number and location of vehicles at a technical position may vary greatly.

The stipulated zone of a technical position (S_{tp}) on average is about twice the stipulated zone of a "Little John" system on the march.

II. Task of Fire for Effect. Ammunition Expenditure Norms

Artillery fire for effect at enemy offensive nuclear weapons is delivered with the aim of either destroying or neutralizing them. The determination of the task of fire for effect at a certain target is shaped by a number of factors and in particular by the future [?] operations of one's own troops, the nature, range [?] and [two words illegible] of the target, the possibility of employing offensive nuclear weapons against them, and the time of their readiness, the quantity and quality of our artillery and availability of ammunition, and the precision of determining target coordinates and settings for fire for effect, etc.

1. Fire for Destruction

The destruction of an enemy launching mount (gun) at a firing (waiting) position or on the march, as well as the destruction of a technical position or transport with nuclear warheads, lies in depriving the target of its combat effectiveness for the time necessary to replace or repair the equipment of the launching mount (missile, gun, or special vehicle) and replace (reinforce) the crew.

Destruction is achieved as a result of a direct hit of a shell on the launching mount (gun or special vehicle), damage of its important assemblies and the

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missile by splinters, as well as by destruction of the crew (personnel).

Offensive nuclear weapons are unobserved targets, and because of this it is not always possible to observe the fire for destruction. Thus, the task of destroying the target is considered carried out as a result of expending the norm of shell consumption that ensures the required probability of at least one hit within the appropriate stipulated target zone. We shall call this norm the norm of shell expenditure for destruction.

The norm of shell expenditure for destruction (N) with the most advantageous methods of bombardment is calculated by the formula:

$$N = K_{?} \frac{E'\underline{d}\,\underline{p} \; ? \; E'\underline{n}\underline{p}}{\underline{S}_{\underline{ts}} \; ? \; \underline{eht} \; (\ell m)} \; /\overline{?} \qquad (25)$$

where $E'\underline{d}_{\underline{p}} = \sqrt{E\,\underline{d}_{\underline{p}} + 0{\cdot}038\underline{G}^2}$ and $E'\underline{n}\,\underline{p} = \sqrt{E^2\underline{n}_{\underline{p}} + 0{\cdot}038\underline{F}^2}$

are the probable errors of range and direction which take into account the influence of the precision of determining the settings for firing for effect ($E\,\underline{d}_{\underline{p}}$ and $E_{\underline{n}_{\underline{p}}}$) and the dimensions (depth G and frontage F) of the area in which the target is located. It should be noted that consideration of the dimensions of the area in which the target is located makes sense only when determining N for destroying batteries of 203.2mm howitzers;

$E\,\underline{d}_{\underline{p}}$ and $E_{\underline{n}_{\underline{p}}}$ are probable errors in the method of determining the settings for fire for effect in range and direction obtained as a result of reducing * the system of errors that accompany

* /Four words missing/ that when determining N, may be utilized mean errors of fire E_{7} and $E_{?}$.

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firing into two groups;

S_{ts} is the stipulated zone (dimensions) of the target; r (ℓm) is a coefficient which depends on the stipulated size of the target (for the targets under consideration r (ℓm) = 1);

K_2 is the coefficient which takes into account the degree of destruction of target; the values of K_2 depending on the degrees of destruction of the target P are given in Table 37.

The degree of destruction of the target is the level of [word missing] effectiveness of fire for destruction. For such targets as offensive nuclear weapons, representing either an individual [word missing] target or a group of such targets [3 lines and one page missing] of cases of fire from various systems by methods of determining settings examined in Chapter III, are given in Table 38.

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Table 37

P	0.10	0.15	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.85	0.90	0.95
$K_?$	1.96[?]	3.22 [?]	4.7?	8.37 [?]	15.0[?]	19.56 [?]	28.18	41.36	62.04	78.50	104.96	155.85

[Note: See paragraph 61]

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Table 38

Expenditure of Shells for Destroying Enemy Offensive

Nuclear Weapons

Location /??/ and nature of target	Method of determining the settings for fire for effect and target coordinates.	Artillery systems	Range of fire (km)							Remarks
			8	10	12	16	20	24	26	
1	2	3	4	5	6	7	8	9	10	11
"Lacrosse" in firing position /??/ and on the march: /??/ transport with "Lacrosse" missiles /??/	a) Full preparation with inclusion of corrections obtained by means of a radar; target coordinates determined by air photo/ (PP-RS)*	130 mm Gun	270	-	350	430	520	620	670	For destroying "Lacrosse" guided missiles in a waiting position, the stated norm f should be increased 5 to 7 times.
		152 mm Gun	210	-	360	460	540	-	-	
		122 mm How	220	320	390	-	-	-	-	
		152 mm.How	200	250	270	-	-	-	-	
	b) Same, - target coordinates determined by means of a radar sct (PP-RS, RS)*	130 mm.Gun	590	-	690	720	770	830	850	
		152 mm.Gun	470	-	650	720	720	-	-	
		122 mm.How	210	310	370	-	-	-	-	
		152 mm.How	190	240	250	-	-	-	-	
	c) Full preparation with inclusion of corrections determined by aid of an aircraft; target coordinates determined by aircraft. (PP-S)*	130 mm.Gun	190	-	280	260 /??/	310	370	400	
		152 mm.Gun	150	-	270	320	370	-	-	
	d) Adjustment fire with aid of an aircraft.	130 mm.Gun	340	-	270	300	340	400	420	
		152 mm.Gun	170	-	320	360	400	-	-	
	e) Adjustment fire with aid of a helicopter.	130 mm.Gun	160	-	300 /?/	470	700	-	-	
		152 mm.Gun	120 /??/	-	470	740	870	-	-	
		122 mm.How	170	300	380	-	-	-	-	
		152 mm.How	150	280 /??/	270 /??/	-	-	-	-	
	f) Adjustment fire with aid of a radar. sct	130 mm.Gun	720	-	750	800	940	900	910	
		152 mm.Gun	570	-	730	790	790	-	-	
		122 mm.How	330	470	510	-	-	-	-	
		152 mm.How	280	370	380	-	-	-	-	

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"Honest John" free rocket in the firing position /?/ and on the march: /?/ transport with "Honest John" rocket	a) PP-RS	130 mm.Gun	250	-	340	410	490	590	660	For destroying the "Honest John" free rocket in an assembly position the stated norm should be increased 5 to 7 times.
		152 mm.Gun	210	-	340	430	510	-	-	
		122 mm How	210	290	360	-	-	-	-	
		152 mm.How	180	230	250	-	-	-	-	
	b) PP-RS, RS	130 mm.Gun	560	-	670	690	720	780	800	
		152 mm.Gun	450	-	620	690	700	-	-	
		122 mm How	200	290	350	-	-	-	-	
		152 mm.How	170	220	240	-	-	-	-	
	c) PP-S	130 mm.Gun	180	-	210	240	300	350	380/?/	
		152 mm.Gun	130	-	250	300	340	-	-	
	d) Adjustment fire with aid of an aircraft.	130 mm.Gun	230	-	270	270	320	360	400	
		152 mm Gun	180	-	300	350	370	-	-	
	e) Adjustment fire with aid of a helicopter.	132 mm.Gun	160	-	310	450	670	-	-	
		152 mm.Gun	120	-	430/?/	700	820	-	-	
		122 mm.How	160	270	350	-	-	-	-	
		152 mm.How	140	210	250	-	-	-	-	
	f) Adjustment fire with aid of a radar.	130 mm.Gun	680	-	720	750	800	850	8/?/60	
		152 mm.Gun	540 /?/	-	680/?/	740	770	-	-	
		122 mm.How	320	470	470	-	-	-	-	
		152 mm.How	270	350/?/	360/?/	-	-	-	-	

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"Little John" free rocket in the firing position [?] and on the march; [?]? with "Little John" rocket

a) PP-RS	130 mm.Gun	570	-	720	710	1080 [?]	1270	????
	152 mm.Gun	440	-	770	770	1170	-	-
	122 mm.How	470	670	770	-	-	-	-
	152 mm.How	470	580 [?]	580 [?]	-	-	-	-
b) PP-RS, RS	130 mm.Gun	11??	-	????	????	????	1700	1770
	152 mm.Gun	???	-	????	????	????	-	-
	122 mm.How	440	670	770	-	-	-	-
	152 mm.How	400	510	???	-	-	-	-
c) PP-S	130 mm.Gun	400	-	470	740	650 [?]	780 [?]	870
	152 mm.Gun	700	-	540	670	770		-
d) Adjustment fire with aid of an aircraft.	130 mm.Gun	520	-	570	610	710	830	860
	152 mm.Gun	370	-	680	770	820	-	-
e) Adjustment fire with aid of a helicopter.	130 mm.Gun	360	-	660	990	1450	-	-
	152 mm.Gun	240	-	990	1500	1800	-	-
	122 mm.How	340	620	780	-	-	-	-
	152 mm.How	320	470	560	-	-	-	-
f) Adjustment fire with aid of a radar.*	130 mm.Gun	1500	-	1550	1650	1750	1850	1850
	152 mm.Gun	1200	-	1500	1650	1650	-	-
	122 mm.How	690	980	1100	-	-	-	-
	152 mm.How	600	790	790	-	-	-	-

For destroying the "Little John" free rocket at a waiting position, the stated norm should be increased... ...times. /Two lines missing/.

* In future, for the sake of brevity, we shall refer to the said methods of determining settings for fire for effect and target coordinates in the manner shown in this table.

......../Table 38 cont

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Table 38 cont

1	2	3	4	5	6	7	8	9	10	11
280 mm Gun in a firing position [?]	a) PP-RS	130 mm.Gun	640	-	840	1050	1300	1600	1750	For destroying a 280 mm gun in a waiting position the stated norm should be increased 1.5 times, and on the march, the stated norm should be increased by 1.5 times.
		152 mm.Gun	480	-	820	1000	1250	-	-	
		122 mm.How	590	810	1100	-	-	-	-	
		152 mm.How	440	510	650	-	-	-	-	
	b) PP-RS, RS	130 mm.Gun	1400	-	1700	1750	1900	2100	2150	
		152 mm.Gun	1100	-	1450	1650	1700	-	-	
		122 mm.How	550	800	1050	-	-	-	-	
		152 mm.How	420	540	610	-	-	-	-	
	c) PP-S	130 mm.Gun	440	-	540	630	780	960	1050	
		152 mm.Gun	300	-	600	710	880	-	-	
	d) Adjustment fire with aid of an aircraft.	130 mm.Gun	580	-	660	700	850	1000	1100	
		152 mm.Gun	420	-	750	850	930 [?]	-	-	
	e) Adjustment fire with aid of a helicopter.	130 mm.Gun	400	-	770	1150	1700	-	-	
		152 mm.Gun	250	-	1050	1?50	2000	-	-	
		122 mm.How	440	750	1100	-	-	-	-	
		152 mm.How	340	500	650	-	-	-	-	
	f) Adjustment fire with aid of a re'ar-set	130 mm.Gun	1700	-	1700	1700	2100	2700	2?50	
		152 mm.Gun	1?00	-	1700	1700	[illegible]	-	-	
		122 mm.How	880 [?]	1150	1500	-	-	-	-	
		152 mm.How	620	830	900	-	-	-	-	

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/Six lines almost illegible but probably read: Battery of 203.2 mm. guns in firing position/.	a) PP-RS	130 mm.Gun	530	-	670	?30	1050	1300	1??0
		152 mm.Gun	470	-	750	940	1??0	-	-
		122 mm.How	4?0	?60	??0	-	-	-	-
		152 mm.How	440	540	??0	-	-	-	-
	b) PP-RS, RS	130 mm.Gun	1000	-	1200	1300	1450	1700	1900
		152 mm.Gun	880	-	1200	1400	1750	-	-
		122 mm.How	460	660	880	-	-	-	-
		152 mm.How	430	530	660	-	-	-	-
	c) PP-S	130 mm.Gun	380	-	450	530	670	850	9?0
		152 mm.Gun	310	-	570	690	970	-	-
	d) Adjustment fire with aid of an aircraft.	130 mm.Gun	450	-	530	570	720	900	10?0
		152 mm.Gun	380	-	660	780	1020	-	-
	e) Adjustment fire with aid of a helicopter.	130 mm.Gun	340	-	590	870	1350	-	-
		152 mm.Gun	260	-	930	1400	?100	-	-
		122 mm.How	380	6?0	930	-	-	-	-
		152 mm.How	?50	500	700	-	-	-	-
	f) Adjustment fire with aid of a radar /?/	130 mm.Gun	1200	-	1300	1450	1600	1850	2000
		152 mm.Gun	1050	-	1350	1500	1??0	-	-
		122 mm.How	650	880	1200/?/	-	-	-	-
		152 mm.How	5?0	730/?/	920	-	-	-	-
/4 lines illegible, by analogy with Table 43 it could read: Technical position/	a) PP-RS	130 mm.Gun	?10	-	?80	370/?/	470	580	640
		152 mm Gun	160/?/	-	280	??0	4?0	-	-
		122 mm How	210	2?0	??0	-	-	-	-
		152 mm.How	1?0	210	2?0/?/	-	-	-	-
	b) PP-S	130 mm.Gun	150	-	1?0	??0	??0	??0	???
		152 mm.Gun	1?0	-	2?0	??0	??0	-	-
	c) Adjustment fire with aid of an aircraft.	130 mm.Gun	200/?/	-	2?0	??0	?10	370/?/	400
		152 mm.Gun	140	-	2?0	??0	??0	-	-
	d) Adjustment fire with aid of a helicopter.	130 mm.Gun	140	-	2?0	400	??0	-	-
		152 mm.Gun	1?0	-	???	??0	??0	-	-
		122 mm How	1?0	??0	??0	-	-	-	-
		152 mm.How	1?0	190 /?/	2?0	-	-	-	-

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An analysis of Table 38 shows that destruction of enemy launching mounts located at waiting positions calls for a great expenditure of shells and is therefore a task that in practice is beyond the capabilities of artillery; as for the destruction of other targets listed in Table 38, these tasks are fully within the capabilities of artillery.

The expenditure of ammunition indicated in Table 38 may be substantially reduced by using chemical shells at the beginning of the fire concentration. According to /26/, the action of one KhSO shell with R-35 /?/ during the first fire concentration is equivalent to:

(a) 1.5 high explosive fragmentation shells (granata) when firing at personnel in the open (when firing at launching mounts and guns in firing positions, as well as at technical positions).

(b) 4/?/ high explosive fragmentation shells when firing at personnel in trenches, dugout shelters, tanks, and armored personnel carriers (when firing at launching mounts in waiting positions and on the march as well as at a battery of 203.2 mm guns).

Fire for destruction of targets is delivered by continuous fire concentration until the norm of shells ensuring their destruction has been expended.

Fire concentration on the targets starts when all, or the greater part of batteries being employed for firing, are ready, in certain very urgent cases as each individual battery is ready.

Batteries called upon to fire for destruction deliver fire at maximum rates.

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When necessary, a check is carried out on the accuracy of fire of each battery during the fire concentration.

2. Fire for Neutralization

As previously stated, enemy offensive nuclear weapons are combined targets. One of the elements of any of these targets is the personnel looking after the equipment: the crew which prepares the mount (gun) for firing at the firing position or is located in shelters when the mount (gun) is at the waiting position; the detail (komanda) (part of the crew) accompanying the mount (gun) or transport with nuclear ammunition on the march; finally, the detail working at the technical position.

By means of artillery fire, it is possible to create such conditions that the target will temporarily lose its combat effectiveness * as a result of the personnel not being able to service the equipment.

Neutralization of a launching mount (gun) at a firing (waiting) position or on the march, as well as neutralization of a maintenance position or transport with nuclear ammunition, consists in making the target lose its combat effectiveness for a period, ensuring the possibility of bringing up other, as a rule nuclear, weapons for its destruction. Neutralization is achieved by creating conditions under which it is impossible for the personnel to carry out their duties at the guns (vehicles), as well as by passing (poputnyy) damage to equipment (vehicles).

* We mean by loss of combat effectiveness a situation in which: firing cannot be carried out from the launching mount (gun); the launching mount (gun) is not capable of leaving the waiting position or carrying out a march; work cannot be carried out at the technical position.

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Neutralization of the enemy offensive nuclear weapons that have been enumerated is thus linked with the capability of hitting the crew members (teams), while they are carrying out duties at the launching mounts (guns, vehicles) when they are (should be) out of the shelters, in positions similar to those of riflemen standing upright.

Stipulated zones of fragmentation effect from ground bursts on riflemen standing upright * taken from work [19] and recalculated for conditions of fire with the most suitable charges are given in Table 39.

Table 39

Stipulated Zones of Destruction for Riflemen in Upright Position

Artillery system	Range (km)						
	8	10	12	16	20	24	28
130 mm Gun	500	-	520	570	620	670	740
152 mm Gun	705	-	705	720	920	-	-
122 mm Howitzer	550	580	715	-	-	-	-
152 mm Howitzer	720	720	1000	-	-	-	-

* Stipulated zones for air bursts at optimum height as shown in [19] are more or less the same as for ground bursts.

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It is accepted that the effectiveness of fire for neutralization is estimated by the probability of hitting a gun crew member (probability of at least one hit inside the stipulated zone of fragmentation effect) during a certain period of time t, during which the crew member /one word missing/ fire the round (move the vehicle out of the zone of fire, etc).

The duration (period) of neutralization is estimated /two words missing/ of such intervals. The effectiveness of fire for neutralization (probability of hitting a crew member) remains constant during the whole period of neutralization.

The possibilities of firing a round, and therefore the magnitude of the time interval t, will depend on the state of readiness for firing at which the mount (gun) was caught by the shelling. If one takes the worst case (the mount or gun was subjected to neutralization at a time when all basic preparatory operations for firing the round had already been carried out), the time interval t will be a minimum one and, depending on the type of mount (gun), will amount to from one to several minutes. Confining ourselves to this worst case, we will take the time interval t to be equal to 2 minutes and to be identical for all types of mounts (guns). We shall also reckon that the time required to move the mount (vehicle) from the zone of shelling will amount to not less than 2 minutes, and for this reason we shall take the size of t in these conditions as well to be equal to 2 minutes.

We shall take the value P = 20 percent as a level of indication of effectiveness of fire for neutralization, that is, the level of probability of striking every gun crew member while it is trying to fire a shot (trying to move the vehicle from the zone of shelling). On the basis of experience during the war the value Pr = 20 percent should be considered quite /?/ adequate for reliable neutralization of a target.

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The expenditure of ammunition ensuring neutralization of a target for a period of [?] 2 minutes is calculated according to formula (25) when [two words missing] (equal to P - 20 percent and S_{ts} is taken from Table 39. [?]. [One word missing] of shells, calculated in such a way, taking into account [one word missing] the constant reliability of neutralization during the period [?] of neutralization, it is advisable to change over to the expenditure [one word missing] per minute, which is shown in Table 40.

[redacted]

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Table 40

/Heading probably reads: Expenditure of Shells in One Minute to Neutralize Enemy Offensive Nuclear Weapons/

Designation & character of target /?/	Means of determining settings for fire for effect /?/ and coordinates of target	Arty. systems	Range (km)						
			8	10	12	16	20	24	26
1	2	3	4	5	6	7	8	9	10
"Lacrosse" guided missile, "Honest John" and "Little John" free rockets, 280mm /?/ gun or 203.2 mm /?/ gun at the firing position in a waiting position & on the march. Technical position & transport with nuclear ammunition	Full preparation with inclusion of corrections obtained by means of a radar set; target coordinates determined by air photo	130mm Gun	7	-	9	11	13	18	18
		152mm Gun	5	-	8	10	12		
		122mm How	6	8	10				
		152mm How	4	6	6				
	Same, target coordinates determined by means of a radar set	130mm Gun	16	-	18	18	19	20	21
		152mm Gun	11	-	15	17	17	-	
		122mm How	6	8	9				
		152mm How	4	6	6				

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Table 40 continued

1	2	3	4	5	6	7	8	9	10
	Full preparation with inclusion of corrections determined by aid of aircraft; target co-ordinates determined by the aircraft	130mm [?] Gun	?	-	?	6	8	9	10
		152mm [?] Gun	?	-	?	7	9	-	-
	Adjustment of fire with aid of aircraft	130mm Gun	?	-	7	7	8	10	10
		152mm Gun	4[?]	-	7	8	9		
	Adjustment of fire with aid of a helicopter	130mm Gun	4	-	8	12	16		
		152mm Gun	3	-	12	17	20		
		122mm How	4	7	9[?]				
		152mm How	3	5	5				
	Adjustment of fire with aid of a radar set	130mm Gun	19	-	19	20	21	22	22
		152mm Gun	13	-	16	18	18		
		122mm How	9	12	13				
		152mm How	7	9	9				

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Let us examine separately the neutralization of a battery of 203.2mm guns. We know that a battery of 203.2mm guns by its nature differs little as a target from an ordinary battery. For this reason, generally speaking, its neutralization should not differ in practice from the one worked out by practical experience for ordinary batteries. Bearing in mind that these batteries may have nuclear ammunition, it would be advisable to work out stricter requirements for their neutralization, that is to increase somewhat the degree of destruction and limit the period of neutralization.

If in the case of conventional batteries being neutralized the degree of destruction is taken to be equal to $P_{\underline{sr}}$ = ?? percent and the period of neutralization on average amounts to one hour, then in our view, when neutralizating batteries of 203.2mm howitzers we should aim at a degree of destruction of $P_{\underline{sr}}$ = ?? percent ($K_?$ = 10.0?), and limit the period of neutralization to 30 minutes.

The norm of shell expenditure to neutralize a battery of 203.2mm guns, calculated for these conditions from formula (?) is given in Table 41.

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Table 41

/Heading probably reads: Expenditure of Shells To Neutralize a Battery of 203.2mm Guns7.

Means of determining settings for fire for effect and coordinates of target	Arty. systems	Range (km)						
		8	10	12	16	20	24	26
1	2	3	4	5	6	7	8	9
a) PP-RS	130mm Gun	140	-	180	210	270	340	400
	152mm Gun	120	-	190	240	350	-	-
	122mm How	120	170	240	-	-		
	152mm How	110	140	180				
b) PP-RS, RS	130mm Gun	2?0	-	300	330	380	440	490
	152mm Gun	220	-	310	360	450		
	122mm How	110	170	230	-			
	152mm How	100	140	170				
c) PP-S	130mm Gun	98	-	120	140	170	220	250
	152mm Gun	??	-	150	180	250		

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Table 41 continued

1		2	3	4	5	6	7	8	9
d)	Adjustment of fire with aid of an aircraft	130mm Gun	110	-	1?0	150	180	230	260
		152mm Gun	90 [?]	-	170	200	260		
e)	Adjustment of fire with aid of a helicopter	130mm Gun	?0	-	140	220	350		
		152mm Gun	?0	-	2?0	370	530		
		122mm How	?0	1?0	2?0				
		152mm How	?0	130?	180				
f)	Adjustment of fire with aid of a radar set	130mm Gun	?10	-	330	370	410	470	520
		152mm Gun	270	-	350	400	470		
		122mm How	1?0	2?0	300				
		152mm How	1?0	1?0	240				

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Table 41 continued

1		2	3	4	5	6	7	8	9
d)	Adjustment of fire with aid of an aircraft	130mm Gun	110	-	1?0	150	180	230	260
		152mm Gun	90/?/	-	170	200	260		
e)	Adjustment of fire with aid of a helicopter	130mm Gun	?0	-	140	220	350		
		152mm Gun	?0	-	2?0	370	530		
		122mm How	?0	1?0	2?0				
		152mm How	?0	130	180				
f)	Adjustment of fire with aid of a radar set	130mm Gun	?10	-	330	370	410	470	520
		152mm Gun	270	-	350	400	470		
		122mm How	1?0	2?0	300				
		152mm How	1?0	1?0	240				

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Fire for neutralization of a target, representing one or another type of enemy offensive nuclear weapon, is carried out by continuous fire concentration up to the moment of delivery of a nuclear strike on the target.

3. Time and Number of Guns Required to Destroy and Neutralize Enemy Offensive Nuclear Weapons

The time during which a certain fire task may be carried out and the number of guns required to ensure the carrying out of this task in the time, together with expenditure of shells, are the most important indexes characterizing the capability of artillery in combatting enemy offensive nuclear weapons.

Fire for destruction of enemy offensive nuclear weapons should, if possible, be short. Otherwise the enemy, convinced of the effectiveness of our fire, will succeed in carrying out countermeasures. If one conforms to a given requirement, the time for carrying out the task of fire for destruction of the target (duration of fire for destruction) will in the main /be governed?/ by that quantity of artillery which, in the circumstances of the situation can be /?/ called upon to deliver fire, as well as by the technical /one word missing/ of these guns /?/ (Table 42).

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[Table 42?]

([Heading illegible]

Artillery system	Range of fire D (km)	Charge	Duration of fire (min.)												Each subsequent hour
			1	3[?]	5	10	15	20	25	30	40	50	60	120	
130mm [?] Gun M - ??	? - 1?	4 - 3[?]	?	12	20	35[?]	45	55	65	75	90	105	120	210	70
	1? - 17	2[?]	-	-	-	-	-	-	-	73	85	98	110	185	53
	17 - ??	1 - ?	-	-	-	-	-	-	-	70	80	90	100	160	35
152mm [?] Gun M - ??	6 - 11	3-2[?]	4	12	20	30	40	50	60	70	82	95	110	200	60
	11 - 1?	1	-	-	-	-	-	-	-	-	81	92	105	160	58
	1?- ?0	?	-	-	-	-	-	-	-	-	80	9?	100	160	35
122mm [?] How ? - ??	?	?	?	16	2?	40	50[?]	60[?]	77	85	102?	1??	134	224	70
	?	?	-	-	-	-	-	??	74	80	94	1??	117	187	60
	? -1?	1 - 0?	-	-	-	-	-	??	70	??	85	90	100	150	50
152mm [?] How D-1	?	?	4	12	20	30	??	??	?0	??	??	98	110	185	62
	?	?	-	-	-	-	??	??	??	??	??	90	100	160	54
	? - 1?	1 -?	-	-	-	-	??	??	??	??	??	??	90	135	45

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With the aid of Table 42, let us see how quickly, using the number of shells shown in Table 38 and depending on the number of batteries called upon to deliver fire, the most characteristic targets can be destroyed when firing at medium (D_{sr}) and extreme (D_{pr}) ranges and using the basic methods of determining settings for fire for effect.

We note that ranges from D_{sr} (12 km) to D_{pr} embrace the whole range of fire possible in practice. Therefore, the values of time obtained will also correspond to the limits of the time range required to destroy the target.

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/First line of heading illegible/ /Table 43?/

Enemy Offensive Nuclear Weapons (from Moment of Opening Fire)

Name and character	Method of determining settings	Artillery system	One battery D_{sr}	One battery D_{pr}	Two batteries D_{sr}	Two batteries D_{pr}	One battalion D_{sr}	One battalion D_{pr}	Two battalions D_{sr}	Two battalions D_{pr}
1	2	3	4	5	6	7	8	9	10	11
"Lacrosse" guided missile at firing position & on the march; transport /?/ with "Lacrosse" missile /?/	PP - RS	130mm Gun	23 /?/	70	8	20	5	12	3	5
		152mm Gun	25 /?/	70	10	18	5	10	3	4
		122mm How	-	20	-	8 /?/	-	5	-	2
		152mm How	-	18	-	6	-	4	-	2
	PP - S	130mm Gun	1?	70	5	10	3	6	2	3
		152mm Gun	1?	27	7	11	4	6	2	3
"Honest John" free rocket at firing position & on march; transport with "Honest John" missile	PP - RS	130mm Gun	?2	?3	?	20	5	15 /?/	3 /?/	4
		152mm Gun	??	43 /?/	9	17	5	9	3 /?/	4
		122mm How	-	1?	-	7	-	4	-	2 /?/
		152mm How	-	1?	-	?	-	4	-	2 /?/
	PP - S	130mm Gun	11	??	?	9	5 /?/	6	2	3
		152mm Gun	1?	??	?	10	4	5	2	?

* when fire is continuous /Location of * in text cannot be seen/

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Table 43 cont.

1	2	3	4	5	6	7	8	9	10	11
"Little John" free rocket at firing position; transport with "Little John" rockets	PP - RS	130mm Gun	80/?/	230	23	72	13	35	5	12
		152mm Gun	80/?/	145	26	52	16	26	6	11
		122mm How	-	102 /?/	-	26	-	12	-	5
		152mm How	-	66	-	18	-	11	-	4
	PP - S	130mm Gun	77	100	18/?/	30	7	16	4	7
		152mm Gun	70	90	18/?/	27	10	16	5	6
280mm and 203.2mm guns at firing position and on the march *	PP - RS	130mm Gun	78/?/	340/?/	28	100 /?/	17	57	6	22
		152mm Gun	84/?/	274	29	65	18	37/?/	7	18
		122mm How		176	-	51	-	18	-	7
		152mm How		77	-	2[illegible]	-	17	-	5
	PP - S	130mm Gun	40/?/	174	75	47	9	22	4	8
		152mm Gun	77	100/?/	20	75	12	20	5	7

* /Two words illegible/ on the march /?/ /one word illegible/ somewhat less /?/ time than in the firing position.

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Table 43 cont.

1	2	3	4	5	6	7	8	9	10	11
/Probably: battery of 203.2mm guns7	PP - RS	130mm Gun	??	?00	20	90	11	46	8	14
		152mm Gun	??	240/??/	??	??	14/??/	27	6	13 /??/
		122mm How		1??	-	??	-	14	-	?
Guns at firing positions/??/	PP - S	1??mm How	-	100	-	24	-	14	-	5
		130mm Gun	30	120	12	40	7	20	4	7
		172mm How	50	120	18	40	11	28/??/	4	8
Technical position	PP - RS	130mm Gun	1?	66/??/	7	19	4	10	2	5
		152mm Gun	19	35/??/	7	14	4	8	2	4
		122mm How	-	18	-	7	-	4	-	2
		152mm How	-	14	-	?	-	4	-	2
	PP - S	130mm Gun	?	??	4	9	3	5/??/	2	3
		152mm Gun	1?	21/??/	?	?	?	?	?	?

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It will be seen from Table 43 that fire for destruction with basic methods of determining settings will require these times:

a) when destroying "Lacrosse" guided missile and "Honest John" free rocket launching mounts at firing positions and on the march, and also destroying a technical position:

one battery - 10 minutes to 1 hour 10 minutes,

two batteries - 5 minutes to 20 minutes,

one battalion - 3 minutes to 15 minutes,

two battalions - 2 minutes to 5 minutes,

b) when destroying a "Little John" free rocket launching mount at the firing position, a 280 mm (203.2mm) gun at the firing position and on the march, as well as a battery of 203.2mm guns at the firing position.

one battery - ?0 minutes to 5/?/ hours 40 minutes,

two batteries - 18/?/ minutes to 1 hour 40 minutes,

one battalion - 10 minutes to 1 hour,

two battalions - 5 minutes to 20 minutes.

It may be concluded that the best way /?/ of meeting the requirements to destroy the target in a short time should be considered the employment of two batteries or one battalion of artillery for fire for destruction at enemy offensive nuclear weapons.

In particular circumstances, when it is essential to destroy the target literally within a few minutes, it is advisable to employ for fire for destruction two artillery battalions, but /?/ no /?/ more.

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The duration of fire for effect at enemy nuclear offensive weapons /three and a half lines missing/ duty combat vehicles (missiles) or combat vehicles (missiles) located at waiting positions by the time of receiving the fire task. The time for readiness of the said combat vehicles (missiles) to open fire is calculated at from 15 to 30 minutes. Consequently, the duration of artillery fire to neutralize the enemy offensive nuclear weapons will be determined within the time limit of 15 to 30 minutes.

Taking the data contained in Table 43 and in the Table of Rate of Fire, we shall also find the quantity of artillery required to neutralize the enemy offensive nuclear weapons within 15 and /30?/ minutes.

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Table 44

Number of Guns Required to Neutralize Enemy Offensive Nuclear Weapons in 15 and 30 Minutes

Description and nature of target	Methods of determining settings	Artillery systems	15 minutes Range (km)			30 minutes [?] Range (km)		
			12	20	26[?]	12	??	26[?]
1	2	3	4	5	6	7	8	9
"Lacrosse" guided missile, "Honest John" and "Little John" free rockets. 280mm gun, T-131 or 203.2mm gun at firing position, waiting position, and on the march, technical position and transport with nuclear ammunition.	PP - RS	130mm Gun	?	?	4	4	?	?
		152mm Gun	?	?	-	4	?	-
		122mm How	4	-	-	4	-	-
		152mm How	?	-	-	?	-	-
	PP-RS, RS	130mm Gun	6	7	7	8	9[?]	9[?]
		152mm Gun	6[?]	7	-	7	8[?]	-
		122mm How	?	-	-	?	-	-
		152mm How	?	-	-	?	-	-
	PP - S	130mm Gun	2[?]	3[?]	4	?	?	?
		152mm Gun	?	4[?]	-	?	?	-

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Table 44 cont.

1	2	3	4	5	6	7	8	9
	Adjustment of fire with aid of an aircraft	130mm Gun	?	3/[?]	4/[?]	?	4[?]	?
		152mm Gun	3/[?]	4/[?]	-	?	?	-
	Adjustment of fire with aid of a helicopter	130mm Gun	3	6	-	4	9	-
		152mm Gun	5	8	-	6	9	-
		122mm How	3	-	-	4	-	-
		152mm How	2	-	-	3/[?]	-	-
	Adjustment of fire with aid of a radar set	*	7	7	8	8	9	10
			6	7	-	7	8	-
			4	-	-	6	-	-
			4	-	-	5	-	-

/* Note: Artillery systems omitted in original in last column7

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It will be seen from Table 44 that the neutralization of any given target can be carried out by a single battery or a maximum of two batteries.

It can be demonstrated that 15 to 25 minutes will also be required for continuous neutralization of a battery of 203.2mm guns at a firing position, and it follows that, in this case as well, neutralization can be carried out by one or two batteries.

4. Methods of Shelling the Target

By the term method of shelling the target in range (po dalnosti) we mean the number of range settings, size of the range bounds, and distribution of shells between range settings, by method of shelling by direction (po napravleniyu) we mean the dimensions of burst distribution (razryvnoy ? veyer), number of azimuth settings (ustanovka uglomera), and the distribution of shells between azimuth settings.

The most advantageous size of the range bound and the most advantageous size of the gap in the distribution of bursts (velichina intervala veyera razryvov) depend /?/ on the precision of determining the settings for fire for effect, the required degree of destruction, the dimensions /?/ of the target in frontage and depth, and on distance /?/.

The most advantageous size of range bound Δh and the most advantageous size of the gap in distribution I_v for a six-gun battery are calculated by means of the well-known formulas *:

$$\Delta h = \sqrt{1.5 \cdot \gamma \cdot E{d_p}^2 - 3.28\, V{d_p}^2} \quad \text{and} \quad (26)$$

$$I_v = \sqrt{0.34 \cdot \gamma \cdot E{n_p}^2 - 0.75\, V{b_p}^2} \quad (27)$$

* If, when calculating the dispersion /5 words missing/ first, fire should be delivered /3 words missing/.

where γ is the coefficient depending on the required degree of destruction of the target;

Ed_p and En_p are mean errors in determining settings for fire of batteries (group of batteries) according to range and azimuth taking into account the depth and frontage of target;

Vd_p and Vb_p are the characteristics of dispersion of shells of a battery (group of batteries) according to range and azimuth.

The values of coefficient γ are given in Table 45.

Table 45

Values of Coefficient γ Depending on the Degree of Destruction

/Two words missing/ P	10	20	30	35	40	50	60[?]	70[?]	80[?]	85[?]	90[?]
γ	0.??	0.?1	?.?1	0.?1	1.0?	1.??	1.??	1.??	2.??	2.??	?.??
/Possibly	0.38	0.61	0.81	0.91	1.01	1.??	1.??	1.78	2.20	2.38	?.??/

An analysis of the results of calculations according to formulas (26) and (27) for different conditions of fire makes it possible to arrive at the following practical concl. sions:

1. Shelling a target by range, irrespective of the method of determining settings and the range of fire of each battery being called upon to deliver fire, leads to:

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[redacted] (b)(3)

-- when firing for neutralization - to one range setting;

-- when firing for destruction - up to three range settings with a range bound of 2 to 3 Vd, when one [?] battery is called upon to deliver fire, and a bound of 1 to 2 Vd when 2 to 3 batteries are called upon for firing; the distribution of shells between range settings is uniform.

2. When firing for neutralization, shelling the target by direction, irrespective of the method used to determine the settings and the number of batteries being employed for firing, is carried out on one bearing setting with good [?] shell distribution, except in the case of fire at a battery of 203.2mm guns, when the distribution of bursts is taken on an average to be equal to 15m.

When firing for destruction, irrespective [?] of the number of batteries being called upon to deliver fire, shelling the target by azimuth is delivered on one [?] bearing setting with the gap in distribution on an average equal to:

- 20 [?] m when the settingsfor fire for effect are determined from the data of adjustment fire on the target with the aid of an aircraft, or from the complete preparation data incorporating corrections obtained with the aid of an aircraft;

- 30 [?] m when settings for fire for effect are determined from the data of adjustment of fire on the target with the aid of a radar set or according to full preparation data incorporating corrections obtained with the aid of a radar set;

- 40 m when the settings for fire for effect are determined from data of adjustment of fire on the target with the aid of a helicopter.

[redacted]

GROUP 1
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[redacted] SECRET

[redacted] (b)(3)

IRONBARK

[redacted] (b)(3)

Chapter Conclusions

1. Artillery can be employed both for the neutralization and destruction of enemy offensive nuclear weapons.

2. Fire for neutralization is delivered by continuous fire concentration up to the moment of a nuclear strike against the target.

The shell expenditure to neutralize a battery of 203.2 mm guns is given in Table 41; expenditure of ammunition per minute to neutralize other enemy offensive nuclear weapons is given in Table 40.

Neutralization of any target can be carried out by a single battery, or two at a maximum.

3. Fire for destruction is delivered by continuous fire concentration up to the full expenditure of the norm of shells shown in Table 38.

To destroy individual mounts of "Lacrosse" guided missiles and "Honest John" free rockets at firing positions and on the march, as well as technical positions, when firing at medium and extreme ranges, 5 to 20 minutes will be required if fire for effect at the target is carried out by two batteries and 3 to 15 minutes if a battalion is called upon to deliver fire.

To destroy "Little John" free rockets, 280 mm and 203.2 mm guns at firing positions, as well as 280 mm guns on the march, by two batteries, 18 minutes to 1 hour 40 minutes will be needed, and by a battalion, from 10 minutes to 1 hour.

In case it is necessary to destroy certain targets in the shortest possible time, not one but two [?] battalions should be called upon to deliver fire for effect.

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